

NASA's UAS NAS Access Project

The vision of the Unmanned Aircraft System (UAS) Integration in the National Airspace System (NAS) Project is “A global transportation system which allows routine access for all classes of UAS.” The goal of the UAS Integration in the NAS Project is to “contribute capabilities that reduce technical barriers related to the safety and operational challenges associated with enabling routine UAS access to the NAS.” This goal will be accomplished through a two-phased approach based on development of system-level integration of key concepts, technologies and/or procedures, and demonstrations of integrated capabilities in an operationally relevant environment. Phase 1 will take place the first two years of the Project and Phase 2 will take place the following three years. The Phase 1 and 2 technical objectives are:

Phase 1

- Developing a gap analysis between current state of the art and the Next Generation Air Transportation System (NextGen) UAS Concept of Operations
- Validating the key technical areas identified by this Project
- Conducting initial modeling, simulation, and flight testing activities
- Completing Subproject Phase 1 deliverables (spectrum requirements, comparative analysis of certification methodologies, etc.) and continue Phase 2 preparation (infrastructure, tools, etc.)

Phase 2

- Providing regulators with a methodology for developing airworthiness requirements for UAS, and data to support development of certifications standards and regulatory guidance
- Providing systems-level, integrated testing of concepts and/or capabilities that address barriers to routine access to the NAS. Through simulation and flight testing, address issues including separation assurance, communications requirements, and human systems integration in operationally relevant environments.

The UAS in the NAS Project will demonstrate solutions in specific technology areas, which will address operational/safety issues related to UAS access to the NAS. Since the resource allocation for this Project is limited (\$150M over the five years), the focus is on reducing the technical barriers where NASA has unique capabilities. As a result, technical areas, such as Sense and Avoid (SAA) and beyond line of sight command and control will not be addressed. While these are critical barriers to UAS access, currently, there is a great deal of global effort being exercised to address these challenge areas. Instead, specific technology development in areas where there is certainty that NASA can advance the research to high technology readiness levels will be the Project's focus. Specific subprojects include Separation Assurance, Human Systems Integration, Communications, Certification, and Integrated Test and Evaluation. Each subproject will transfer technologies to relevant key stakeholders and decision makers through research transition teams, technology forums, or through other analogous means.

Under the Separation Assurance subproject, NextGen aircraft-to-aircraft separation assurance concepts and how well conflict detection/resolution algorithms apply to UAS will be assessed. This includes evaluations of different responsibilities for maintaining separation, including a concept in which the remote pilot is responsible for staying away from other aircraft, a concept in which the air vehicle autonomously separates itself from other aircraft, and a more traditional concept in which the air traffic controller is still responsible for separation (we call these different “functional allocations” for separation responsibility). The challenge in this subproject will be to address the very different performance characteristics (e.g., maximum climb rates) that many UAS have in comparison to manned, jet aircraft and the delay in execution of a maneuver because the pilot is remote from the aircraft. Evaluations of the concepts will be accomplished in flight tests with realistic command and control latencies and trajectory prediction uncertainties. The output will be an assessment of how NextGen separation assurance systems with different functional allocations perform for UAS in mixed operations with manned aircraft.

Under the Human Systems Integration subproject, a research test-bed and database to provide data and proof of concept for Ground Control Station (GCS) operations in the NAS will be developed. UAS characteristics that make them different from manned aircraft and how to display airspace information without increasing workload will be addressed. Human-automation interaction and responsibility between onboard automation and the aircraft operator will also be assessed. The output will be a body of work which will be coordinated with standards organizations to develop human factors guidelines for GCS operation in the NAS. These guidelines will help the FAA develop specific standards against which to assess UAS GCS compliance.

Under the Communications subproject, data and rationale to obtain appropriate frequency spectrum allocations to enable the safe and efficient operation of UAS in the NAS will be developed. There is currently no spectrum allocated for civil UAS use. This work will support the United States’ efforts to obtain dedicated UAS spectrum at the World Radio Conference. Candidate UAS command and control system/subsystem test equipment, which complies with UAS frequency regulations, International Civil Aviation Organization Standards and Recommended Practices, and FAA/RTCA Minimum Operational Performance Standards/Minimum Aviation System Performance Standards for UAS will also be developed. This will include analysis of proposed command & control security recommendations for public and civil UAS operations in the NAS.

Under the Certification subproject, a UAS classification scheme and approach to determining airworthiness requirements applicable to all UAS digital avionics will be defined. The current aircraft classification scheme and corresponding airworthiness requirements are not directly applicable to the full range UAS. Hazard and risk-related data to support development of type design criteria and best development practices will also be developed. Little UAS specific data (incident, accident, and reliability) exists in a civil context to support development of standards and regulations.

Under the Integrated Test and Evaluation (IT&E) subproject, the technologies developed within the first three subprojects will be validated through a series of fast time simulations, high-fidelity human-in-the-loop simulations, and integrated flight tests in a relevant environment. A Live Virtual Constructive (LVC)

distributed test infrastructure is the cornerstone of all IT&E tests. Preparing the LVC infrastructure for NASA flight tests will include modifications to simulation facilities, unmanned aircraft, and GCSs with critical enabling capabilities. Through the LVC environment, the Project anticipates developing nodes with our domestic and international partners. This will allow the Project low cost options to expand the flight and simulation asset base (such as linking simulators at the FAA Technical Center or live flights flown in Australia). It will also allow for the inclusion of piggy-back experiments with the Project's partners (such as testing candidate SAA sensors/algorithms in the LVC environment).

The final deliverables from the IT&E subproject will provide decision makers evaluation of UAS integration in the NAS from integrated tests with UAS separation assurance algorithms, UAS GCS concepts, and UAS safety-of-flight communication systems concepts.

At the end of the five-years, the Project expects to have developed data, analysis, and recommendations to key stakeholders based on actual flight tests in a relevant environment. The Project will work with these key stakeholders to ensure that it is delivering what is requested by them. This will produce validated and significant evidence leading to the reduction or elimination of NAS access barriers.